

**WHAT IS CLAIMED IS:**

1           1.     A method for improving performance of an electrophoretic display,  
2     which method comprises adding a high absorbance dye or pigment to at least one  
3     of the electrode protecting layers in the display.

1           2.     The method of Claim 1 wherein said dye or pigment has an  
2     absorption band in the range of 320-800 nm.

1           3.     The method of Claim 2 wherein said dye or pigment has an  
2     absorption band in the range of 400-700 nm.

1           4.     The method of Claim 1 wherein said dye or pigment is selected from  
2     the group consisting of metal phthalocyanine or naphthalocyanines, metal  
3     porphines, azo, squaraine, perylene and croconine dyes and mixtures thereof.

1           5.     The method of Claim 4 wherein said metal in metal phthalocyanine or  
2     naphthalocyanines is Cu, Al, Ti, Fe, Zn, Co, Cd, Mg, Sn, Ni, In, Ti, V or Pb.

1           6.     The method of Claim 4 wherein said metal in metal porphines is Co,  
2     Ni or V.

1           7.     The method of Claim 4 wherein said azo dye is a diazo or polyazo  
2     dye.

1           8.     The method of Claim 1 wherein said dye or pigment is a charge  
2     generating material used in organic photoconductors.

1           9.     The method of Claim 1 wherein said dye or pigment is selected from  
2     the group consisting of Cu phthalocyanines, Cu naphthalocyanines C.I. Solvent  
3     Blue 67, Ni phthalocyanine, Ti phthalocyanine, Ni tetraphenylporphine, Co  
4     phthalocyanine, Orasol™ Blue GL, Orasol™ Red BL, Orasol™ Yellow 2GLN,  
5     Orasol™ Black CN, Orasol™ Black RL1, tetraphenylporphine vanadium(IV) oxide  
6     complex and their alkylated or alkoxyated derivatives, C.I. Solvent Black 29,  
7     Sudan Black B, Sudan Blue, Sudan R, Sudan Yellow, Sudan I, Sudan II, Sudan III,  
8     Sudan IV, 1-(4-dimethylamino-pheny)-3-(4-dimethylimmonium-cyclohexa-2,5-dien-  
9     1-ylidene)-2-oxo-cyclobuten-4-olate, 1-(4-methyl-2-morpholino-selenazo-5-yl)-3-

(2,5-dihydro-4-methy-2[morpholin-1-ylidene-onium]-selenzaol-5-ylidene)-2-oxo-cyclobuten-4-olate, 1-(2-dimethylamino-4-phenyl-thiazol-5-yl)-3-(2,5-dihydro-2-dimethylimmonium-4-phenyl)-thiazol-5-ylidene)-2-oxo-cyclobuten-4-olate; 2,9-di(2-hydroxyethyl)-anthra[2.1,9-def:6,5,10-d'e'f']diisoquinoline-1,3,8,10-tetrone, 9-di(2-methoxyethyl)-anthra[2.1,9-def:6,5,10-d'e'f']diisoquinoline-1,3,8,10-tetrone, bisimidazo[2,1-a:2',1'-a']anthra[2.1,9-def:6,5,10-d'e'f']diisoquinoline-dione and anthra[2'',1'',9'':4,5,6:6'',5'',10'':4',5',6']-diisoquinoline[2,1-a:2'1'-a]diperimidine-8,20-dione and mixtures thereof.

10. An electrode protecting layer composition comprising a high absorbance dye or pigment.

11. The composition of Claim 10 wherein said dye or pigment has an absorption band in the range of 320-800 nm.

12. The composition of Claim 11 wherein said dye or pigment has an absorption band in the range of 400-700 nm.

13. The composition of Claim 10 which is a primer layer composition comprising a thermoplastic, thermoset or a precursor thereof and a high absorbance dye or pigment.

14. The composition of Claim 13 wherein said thermoplastic or thermoset or precursor thereof is selected from the group consisting of polyvinylbutyral, cellulose acetate butyrate, poly (alkyl acrylates), poly(alkyl methacrylates), polyethers, polyurethanes, polyamides, polyesters, polycarbonates, multifunctional acrylates or methacrylates, vinylbenzenes, vinylethers, epoxides and oligomers or polymers thereof and mixtures thereof.

15. The composition of Claim 10 which is a sealing layer composition comprising a polymeric material and a high absorbance dye or pigment.

16. The composition of Claim 15 wherein said polymeric material is selected from the group consisting of thermoplastic elastomers, polyvalent acrylate or methacrylate, cyanoacrylates, polyvalent vinyl, polyvalent epoxide, polyvalent

4 isocyanate, polyvalent allyl and oligomers or polymers containing crosslinkable  
5 functional groups and mixtures thereof.

1 17. The composition of Claim 10 which is an adhesive layer composition  
2 comprising an adhesive material and a high absorbance dye or pigment.

1 18. The composition of Claim 17 wherein said adhesive material is  
2 selected from the group consisting of acrylics, styrene-butadiene copolymers,  
3 styrene-butadiene-styrene block copolymers, styrene-isoprene-styrene block  
4 copolymers, polyvinylbutyral, cellulose acetate butyrate, polyvinylpyrrolidone,  
5 polyurethanes, polyamides, ethylene-vinylacetate copolymers, epoxides,  
6 multifunctional acrylates, vinyls, vinylethers and oligomers, polymers and  
7 copolymers thereof and mixtures thereof.

1 19. The composition of Claim 10 wherein said dye or pigment is in the  
2 amount of from 0.1 to 30% by weight of the total solid content of the electrode  
3 protecting layer.

1 20. The composition of Claim 19 wherein said dye or pigment is in the  
2 amount of from 2 to 20% by weight of the total solid content of the electrode  
3 protecting layer.

1 21. A method for improving performance of an electrophoretic display,  
2 which method comprises adding conductive particles to one of the electrode  
3 protecting layers of the display.

1 22. The method of Claim 21 wherein said conductive particles are formed  
2 from a conductive material selected from the group consisting of organic  
3 conducting compounds or polymers, carbon black, carbonaceous materials,  
4 graphite, metals, metal alloys and conductive metal oxides and mixtures thereof.

1 23. The method of Claim 22 wherein said metal or metal alloy is selected  
2 from the group consisting of Au, Ag, Cu, Fe, Ni, In, Al and an alloy thereof and  
3 mixtures thereof.

1        24. The method of Claim 22 wherein said metal oxide is selected from  
2 the group consisting of indium-tin-oxide (ITO), indium-zinc-oxide (IZO), antimony-  
3 tin oxide (ATO) and barium titanate ( $\text{BaTiO}_3$ ).

1        25. The method of Claim 22 wherein said organic conducting compound  
2 or polymer is selected from the group consisting of poly(p-phenylene vinylene),  
3 polyfluorene, poly(4,3-ethylenedioxythiophene), poly(1,2-bis-ethylthio-acetylene),  
4 poly(1,2-bis-benzylthio-acetylene), 5,6,5',6'-tetrahydro-[2,2']bi[1,3]dithiolo[4,5-  
5 b][1,4]dithiinyliene], 4,5,6,7,4',5',6',7'-octahydro-[2,2']bi[benzo[1,3]dithiolyliene],  
6 4,4'-diphenyl-[2,2']bi[1,3]dithiolyliene, 2,2,2',2'-tetraphenyl-bi-thiapyran-4,4'-  
7 diylidene, hexakis-bezylthio-benzene and derivatives thereof and mixtures thereof.

1        26. The method of Claim 22 wherein said conductive particles are  
2 organic or inorganic particles overcoated with a conductive material.

1        27. The method of Claim 22 wherein the amount of the conductive  
2 material added into the electrode protecting layer is in the range of from 0.1% to  
3 40% by weight of the total solid of the electrode protecting layer.

1        28. The method of Claim 22 wherein the amount of the conductive  
2 material added into the electrode protecting layer is in the range of from 5% to  
3 30% by weight of the total solid of the electrode protecting layer.

1        29. The method of Claim 22 wherein the conductive material is in the  
2 form of particles of 0.01 to 5  $\mu\text{m}$ .

1        30. The method of Claim 29 wherein the conductive material is in the  
2 form of particles of 0.05 to 2  $\mu\text{m}$ .

1        31. An electrode protecting layer composition comprising conductive  
2 particles.

1        32. The composition of Claim 31 wherein said conductive particles are  
2 formed from a conductive material selected from the group consisting of organic  
3 conducting compounds or polymers, carbon black, carbonaceous materials,

4 graphite, metals, metal alloys or conductive metal oxides and organic or inorganic  
5 particles overcoated with a conductive material and mixtures thereof.

1 33. The composition of Claim 32 which is a primer layer composition  
2 comprising a thermoplastic, thermoset or a precursor thereof and conductive  
3 particles.

1 34. The composition of Claim 33 wherein said thermoplastic or thermoset  
2 is selected from the group consisting of polyvinylbutyral, cellulose acetate butyrate,  
3 poly (alkyl acrylates), poly(alkyl methacrylates), polyethers, polyurethanes,  
4 polyamides, polyesters, polycarbonates, multifunctional acrylates or methacrylates,  
5 vinylbenzenes, vinylethers, epoxides and oligomers or polymers thereof and  
6 mixtures thereof.

1 35. The composition of Claim 32 which is a sealing layer composition  
2 comprising a polymeric material and conductive particles.

1 36. The composition of Claim 35 wherein said polymeric material is  
2 selected from the group consisting of thermoplastic elastomers, polyvalent acrylate  
3 or methacrylate, cyanoacrylates, polyvalent vinyl, polyvalent epoxide, polyvalent  
4 isocyanate, polyvalent allyl and oligomers or polymers containing crosslinkable  
5 functional groups and mixtures thereof.

1 37. The composition of Claim 32 which is an adhesive layer composition  
2 comprising an adhesive material and conductive particles.

1 38. The composition of Claim 37 wherein said adhesive material is  
2 selected from the group consisting of acrylics, styrene-butadiene copolymers,  
3 styrene-butadiene-styrene block copolymers, styrene-isoprene-styrene block  
4 copolymers, polyvinylbutyral, cellulose acetate butyrate, polyvinylpyrrolidone,  
5 polyurethanes, polyamides, ethylene-vinylacetate copolymers, epoxides,  
6 multifunctional acrylates, vinyls, vinylethers and oligomers, polymers and  
7 copolymers thereof and mixtures thereof.

1           39.    The composition of Claim 31 wherein said conductive particles are in  
2   the amount of from 0.1 to 40% by weight of the total solid content of the electrode  
3   protecting layer.

1           40.    The composition of Claim 39 wherein said conductive particles are in  
2   the range of from 5 to 30% by weight of the total solid content of the electrode  
3   protecting layer.

1           41.    A method for improving performance of an electrophoretic display,  
2   which method comprises adding a charge transport material to one of the electrode  
3   protecting layers of the display.

1           42.    The method of Claim 41 wherein said charge transport material is a  
2   hole transport material having an oxidation potential less than 1.4 V (vs SCE).

1           43.    The method of Claim 42 wherein said charge transport material is a  
2   hole transport material having an oxidation potential less than 0.9 V (vs SCE).

1           44.    The method of Claim 43 wherein said hole transport material has an  
2   oxidation potential ranging from 0.5 to 0.9 V (vs SCE).

1           45.    The method of Claim 42 wherein said hole transport material is  
2   selected from the group consisting of pyrazolines, hydrazones, oxazoles,  
3   oxadiazoles, enamines, carbazoles, arylamines, triarylmethanes, biphenyls,  
4   dienes, dienones, triazoles, metal phthalocyanines, metal naphthalocyanines and  
5   oligomeric or polymeric derivatives thereof and mixtures thereof.

1           46.    The method of Claim 45 wherein said pyrazoline is 1-phenyl-3-(4'-  
2   dialkylaminostyryl)-5-(4''-dialkylaminophenyl)pyrazoline.

1           47.    The method of Claim 45 wherein said hydrazone is p-  
2   dialkylaminobenzaldehyde- N,N-diphenylhydrazone, 9-ethyl-carbazole-3-aldehyde-  
3   N-methyl-N-phenylhydrazone, pyrene-3-aldehyde-N,N-diphenylhydrazone, 4-  
4   diphenylamino-benzaldehyde-N,N-diphenylhydrazone, 4-N,N-bis(4-methylphenyl)-  
5   amino-benzaldehyde-N,N-diphenylhydrazone, 4-dibenzylamino-benzaldehyde-N,N-

6 diphenylhydrazone or 4-dibenzylamino-2-methyl-benzaldehyde-N,N-  
7 diphenylhydrazone.

1 48. The method of Claim 45 wherein said oxazole or oxadiazole is 2,5-  
2 bis-(4-dialkylaminophenyl)-4-(2-chlorophenyl)oxazole, 2,5-bis-(4-N,N'-  
3 dialkylaminophenyl)-1,3,4-oxadiazole, 2-(4-biphenyl)-5-(4-tert-butylphenyl)-1,2,3-  
4 oxadiazole, 2,2'-(1,3-phenylene)bis[5-[4-(1,1-dimethylethyl)phenyl] 1,3,4  
5 oxadiazole, 2,5-bis(4-methylphenyl)-1,3,4-oxadiazole or 1,3-bis(4-(4-  
6 diphenylamino)-phenyl-1,3,4-oxadiazol-2-yl)benzene.

1 49. The method of Claim 45 wherein said enamine, carbazole or  
2 arylamine is bis(p-ethoxyphenyl)acetaldehyde di-p-methoxyphenylamine enamine,  
3 N-alkylcarbazole, trans-1,2-biscarbazoyl-cyclobutane, 4,4'-bis(carbazol-9-yl)-  
4 biphenyl, N,N'-diphenyl-N,N'-bis(3-methylphenyl)-[1,1-bi[phenyl]-4,4'-diamine, 4,4'-  
5 bis(N-naphthyl-N-phenyl-amino) biphenyl (or N,N'-di(naphthalene-2-yl)-N,N'-  
6 diphenyl-benzidine); 4,4',4''-trimethyl-triphenylamine, N-biphenyl-N-phenyl-N-(3-  
7 methylphenyl)-amine, 4-(2,2-bisphenyl-ethen-1-yl)triphenylamine, N,N'-di-(4-  
8 methyl-phenyl)N,N'-diphenyl-1,4-phenyldiamine, 4-(2,2-bisphenyl-ethen-1-yl)-  
9 4',4''-dimethyl-triphenylamine, N,N,N',N'-tetraphenylbenzidine, N,N,N',N'-tetrakis(4-  
10 methyphenyl)-benzidine, N,N'-bis-(4-methylphenyl)-N,N'-bis-(phenyl)-benzidine,  
11 4,4'-bis(dibenz-azepin-1-yl)-biphenyl; 4,4'-bis(dihydro-dibenz-azepin-1-yl)-biphenyl,  
12 di-(4-dibenzylamino-phenyl)-ether, 1,1-bis-(4-bis(4-methyl-phenyl)-amino-  
13 phenyl)cyclohexane, 4,4'-bis(n,N-doiphenylamino)-quaterphenyl, N,N,N',N'-  
14 tetrakis(naphtha-2-yl)benzidine, N,N'-bis(phenanthren-9-yl)-N,N'-bis-phenyl-  
15 benzidine, N,N'-bis(phenanthren-9-yl)-N,N'-bis-phenyl-benaidine, 4,4',4''-  
16 tris(carbazol-9-yl)-triphenylamine, 4,4',4''-tris(N,N-diphenylamino)-triphenylamine,  
17 4,4'-bis(N-(1-naphthyl)-N-phenyl-amino)-quaterphenyl, 4,4',4''-tris(N-(1-naphthyl)-  
18 N-phenyl-amino) triphenylamine or N,N'-diphenyl-N,N'-bis(4'-(N,N-bis(naphthy-1-  
19 yl)-amino)-biphenyl-4-yl)-benzidine.

1           50.    The method of Claim 45 wherein said triarylmethane or biphenyl is  
2 bis(4-N,N-dialkylamino-2-methylphenyl)phenylmethane or 4,4'-bis(2,2-diphenyl-  
3 ethen-1-yl)-biphenyl.

1           51.    The method of Claim 45 wherein said diene or dienone is 1,1,4,4-  
2 tetraphenyl-butadiene, 4,4'-(1,2-ethanediylidene)-bis(2,6-dimethyl-2,5-  
3 cyclohexadien-1-one), 2-(1,1-dimethylethyl)-4-[3-(1,1-dimethylethyl)-5-methyl-4-oxo-  
4 2,5-cyclohexa-dien-1-ylidene]-6-methyl-2,5-cyclohexadien-1-one, 2,6-bis(1,1-  
5 dimethylethyl)-4-[3,5-bis(1,1-dimethylethyl)-4-oxo-2,5-cyclohexa-dien-1-ylidene]-2,5-  
6 cyclohexadien-1-one or 4,4'-(1,2-ethanediylidene)-bis(2,6-(1,1-dimethyl-ethyl)-2,5-  
7 cyclohexadien-1-one).

1           52.    The method of Claim 45 wherein said triazole is 3,5-bis(4-tert-  
2 phenyl)-4-phenyl-triazole or 3-(4-biphenyl)-4-phenyl-5-tert-butylphenyl-1,2,4-  
3 triazole.

1           53.    The method of Claim 45 wherein said metal phthalocyanine or  
2 naphthalocyanine is Cu phthalocyanine, Cu naphthalocyanine or an alkylated  
3 derivative thereof.

1           54.    The method of Claim 41 wherein said charge transport material is an  
2 electron transport material.

1           55.    The method of Claim 54 wherein said electron transport material is  
2 selected from the group consisting of electron deficient compounds in the general  
3 classes of fluorenones, nitro and nitrile compounds and oligomeric or polymeric  
4 derivatives thereof and mixtures thereof.

1           56.    The method of Claim 55 wherein said electron transport compound is  
2 2,4,7-trinitro-9-fluorenone, 2-(1,1-dimethylbutyl)-4,5,7-trinitro-9-fluorenone, (4-  
3 butoxycarbonyl-9-fluorenylidene)malononitrile, 2,6-di-tert-butyl-4-  
4 dicyanomethylene-4-H-thiopyran-1,1-dioxide, 2-(4-(1-methyl-ethyl)-phenyl)-6-  
5 phenyl-4H-thiopyran-4-ylidene]-propanedinitril-1,1-dioxide or 2-phenyl-6-



6 methylphenyl-4-dicyanomethylene-4-H-thiopyran-1,1-dioxide or 7,7,8,8-  
7 tetrachcyanonquinodimethane.

1 57. An electrode protecting layer composition comprising a charge  
2 transport material.

1 58. The composition of Claim 57 wherein said charge transport material  
2 is a hole transport material or an electron transport material.

1 59. The composition of Claim 57 wherein said charge transport material  
2 is 4-(dicyanomethylene)-2-methyl-6-(julolidin-4-yl-vinyl)-4H-pyran, bis(2-2-  
3 hydroxyphenyl)-benz-1,3-thiazolato)-Zn complex, bis(2-(2-hydroxyphenyl)-benz-  
4 1,3-oxadiazoleato)-Zn complex, tris(8-hydroxy-chinolinato)-Al complex, tris(8-  
5 hydroxy-4-methyl-chinolinato)-Al complex or tris(5-chloro-8-hydroxy-chinolinato)-Al  
6 complex.

1 60. The composition of Claim 57 which is a primer layer composition  
2 comprising a thermoplastic, thermoset or a precursor thereof and a charge  
3 transport material.

1 61. The composition of Claim 60 wherein said thermoplastic or thermoset  
2 material is selected from the group consisting of polyvinylbutyral, cellulose acetate  
3 butyrate, poly (alkyl acrylates), poly(alkyl methacrylates), polyethers,  
4 polyurethanes, polyamides, polyesters, polycarbonates, multifunctional acrylates or  
5 methacrylates, vinylbenzenes, vinylethers, epoxides and oligomers or polymers  
6 thereof and mixtures thereof.

1 62. The composition of Claim 57 is a sealing layer composition  
2 comprising a polymeric material and a charge transport material.

1 63. The composition of Claim 62 wherein said polymeric material is  
2 selected from the group consisting of thermoplastic elastomers, polyvalent acrylate  
3 or methacrylate, cyanoacrylates, polyvalent vinyl, polyvalent epoxide, polyvalent  
4 isocyanate, polyvalent allyl and oligomers or polymers containing crosslinkable  
5 functional groups and mixtures thereof.

1           64.    The composition of Claim 57 which is an adhesive layer composition  
2 comprising an adhesive material and a charge transport material.

1           65.    The composition of Claim 64 wherein said adhesive material is  
2 selected from the group consisting of acrylics, styrene-butadiene copolymers,  
3 styrene-butadiene-styrene block copolymers, styrene-isoprene-styrene block  
4 copolymers, polyvinylbutyral, cellulose acetate butyrate, polyvinylpyrrolidone,  
5 polyurethanes, polyamides, ethylene-vinylacetate copolymers, epoxides,  
6 multifunctional acrylates, vinyls, vinylethers and oligomers, polymers and  
7 copolymers thereof and mixtures thereof.

1           66.    The composition of Claim 57 wherein said charge transport material  
2 is in the amount of from 0.1 to 30% by weight of the total solid content of the  
3 electrode protecting layer.

1           67.    The composition of Claim 66 wherein said charge transport agent is  
2 in the amount of from 2 to 20% by weight of the total solid content of the electrode  
3 protecting layer.

1           68.    Use of a high absorbance dye or pigment or conductive particles or a  
2 charge transport material or a combination thereof for improving performance of an  
3 electrophoretic display.

1           69.    An electrophoretic display comprising at least one electrode  
2 protecting layer formed of a composition comprising a high absorbance dye or  
3 pigment or conductive particles, or a charge transport material or a combination  
4 thereof.

1           70.    The electrophoretic display of Claim 69 which is prepared from the  
2 microcup technology.